Project Report

Team ID	**PNT2022TMID47019**
Project Name	**Smart waste management system for metropolitan cities**

1. INTRODUCTION

1.1 Project Overview:

Our waste generation is constantly growing to form a global garbage crisis. Even though we indulge in creating a more sustainable and greener, we still fail to handle our waste generation and management. Combining technology support with a vision of social, economic and environmental sustainability is the best way out of this problem. It is done in the following manner. The smart bin system undergoes a thorough system check and battery level monitoring in order to function efficiently. If the battery level is found to be low, it has to be recharged immediately, else it can proceed to the next step. The threshold level levels of the bin are indicated my multiple sensors attached to bin. If the garbage exceeds the level, then an alert message is sent to the garbage collectors as well as to the municipality or area administration. The area in which garbage is found to overflow is allocated to respective garbage collectors in the form of messages through GSM system. Once the waste bin is emptied, an information update is sent to the municipality and server is updated. This is how the waste from bins can be efficiently handled and managed using technology which in turn keeps the environment clean and healthy.

1.2 Purpose:

We amalgamate technology along with waste management in order to effectively create a safe and a hygienic environment. Smart waste management is about using technology and data to create a more efficient waste industry. Based on IoT (Internet of Things) technology, smart waste management aims to optimize resource allocation, reduce running costs, and increase the sustainability of waste services. This makes it possible to plan more efficient routes for the trash collectors who empty the bins, but also lowers the chance of any bin being full for over a week. A good level of coordination exists between the garbage collectors and the information supplied via technology. This makes them well aware of the existing garbage level and instigate them whenever the bins reach the threshold level. They are sent with alert messages so that they can collect the garbage on time without littering the surrounding area. The fill patterns of specific containers can be identified by historical data and managed accordingly in the long term. In addition to hardware solutions, mobile applications are used to overcome the challenges in the regular waste management system, such as keeping track of the drivers while they are operating on the field. Thus, smart waste management provides us with the most optimal way of managing the waste in an efficient manner using technology.

2. LITERATURE SURVEY:

2.1 Existing problem:

Waste management has become an alarming challenge in local towns and cities across the world. Often the local area bins are overflowing and the municipalities are not aware of it. This affects the residents of that particular area in numerous ways starting from bad odour to unhygienic and unsafe surroundings. Poor waste management - ranging from non-existing collection systems to ineffective disposal -causes air pollution, water and soil contamination. Open and unsanitary areas contribute to contamination of drinking water and can cause infection and transmit diseases. Toxic components such as Persistent Organic Pollutants (POPs) pose particularly significant risks to human health and the environment as they accumulate through the food chain. Animals eating contaminated plants have higher doses of contaminants than if they were directly exposed. Precipitation or surface water seeping through waste will absorb hazardous components from landfills, agricultural areas, feedlots, etc. and carry them into surface and groundwater. Contaminated groundwater also poses a great health risk, as it is often used for drinking, bathing and recreation, as well as in agricultural and industrial activities. Landfills and waste transfer stations can attract various pests (insects, rodents, gulls, etc.) that look for food from waste. These pests can spread diseases through viruses and bacteria (i.e., salmonella and e-coli), which are a risk to human health.

2.2 References:

PAPER 1:

TITLE: IoT Based Waste Management for Smart City

AUTHOR NAME: Parkash Tambare, Prabu Venkatachalam

PUBLICATION YEAR: 2016 **DESCRIPTION:**

In the current situation, we frequently observe that the trash cans or dust cans that are located in public spaces in cities are overflowing due to an increase in the amount of waste produced each day. We are planning to construct "IoT Based Waste Management for Smart Cities" to prevent this from happening because it makes living conditions for people unsanitary and causes unpleasant odours in the surrounding area. There are numerous trash cans scattered throughout the city or on the campus that are part of the proposed system. Each trash can is equipped with a low-cost embedded device that tracks the level of the trash cans and an individual ID that will enable it to be tracked and identified.

PAPER 2:

AUTHOR NAME: Mohammad Aazam, Marc St-Hilaire, Chung-Horng Lung, Ioannis Lambadaris **PUBLICATION YEAR:** 2016

DESCRIPTION:

Each bin in the Cloud SWAM system that Mohammad Aazam et al suggested has sensors that can detect the amount of waste inside. There are separate bins for organic, plastic/paper/bottle/glass, and metal waste. This way, each form of waste is already divided, and it is known how much and what kind of waste is collected thanks to the status. Different entities and stakeholders may benefit from the accessibility of cloud-stored data in different ways. Analysis and planning can begin as soon as garbage is collected and continue through recycling and import/export-related activities. Timely garbage collection is provided via the Cloud SWAM system. A timely and effective method of waste collection improves health, hygiene, and disposal.

PAPER 3:

TITLE: Arduino Microcontroller Based Smart Dustbins for Smart Cities

AUTHOR NAME: K. Suresh, S. Bhuvanesh and B. Krishna Devan

PUBLICATION YEAR: 2019 **DESCRIPTION:**

In this paper, a technique for cleaning up our surroundings and environment is described. The Indian government just began work on a smart city initiative, and in order for these towns to be smarter than they already are, the garbage collection and disposal system must be improved upon. Self-Monitoring Automated Route Trash (SMART) dustbins are intended for use in smart buildings such as colleges, hospitals, and bus stops, among other places. In this study, we have employed the PIR and Ultrasonic sensors to detect human presence, the Servomotor to open the dustbin lid, and the Ultrasonic sensor to detect the level of rubbish. Signals between two trash cans are transmitted using a communication module, and the GSM module sends the message to the operator.

PAPER 4:

AUTHOR NAME: Mohd Helmy Abd Wahab, Aeslina Abdul Kadir, Mohd

Razali Tomari and Mohamad Hairol Jabbar

PUBLICATION YEAR: 2014 **DESCRIPTION:**

Proposed a smart recycle bin that can handle the recycling of plastic, glass, paper, and aluminium cans. It generates a 3R card after automatically determining the value of the trash thrown away. The recycle system makes it possible to accumulate points for placing waste into designated recycle bins. By allowing the points to be redeemed for goods or services, such a system promotes recycling activities. The system keeps track of information on disposal procedures, materials disposed of, user identification, and points accrued by the user. To use the recycle bin, the user must tap his card to the designated RFID reader. Doors to recycling bins are opened, and rubbish is placed one by one.

PAPER 5:

TITLE: Waste Management Initiatives in India For Human Wellbeing

AUTHOR NAME: Dr. Raveesh Agarwal, Mona Chaudhary and Jayveer Singh

PUBLICATION YEAR: 2015 **DESCRIPTION:**

The objective of this paper is to examine the present methods used in India for the welfare of its people in different waste management efforts. The other goal is to offer advice on how to make Indian municipalities' trash disposal procedures better. On secondary research, this essay is founded. The system is improved by looking at the reports that have already been written about waste management and the suggestions made for improvement by planners, NGOs, consultants, government accountability organisations, and important business leaders. It provides in-depth understanding of the various waste management programmes in India and identifies areas where waste management might be improved for societal benefit. The essay makes an effort to comprehend the crucial part that our nation's official waste management sector plays in the waste management process.

PAPER 6:

AUTHOR NAME: Fachmin F olianto, Yong Sheng Low and Wai Leong Yeow

PUBLICATION YEAR: 2015 **DESCRIPTION:**

A three-tier design is proposed for the smart bin system. Each Smartbin is equipped with an ultrasonic sensor that detects bin fullness and records readings and sensor statuses. The gateway nod, which is a part of every sensor cluster, receives the sensor reading and transmits it. To the backend server, it transmits the data. The back end server's analytics module examines the information that the bin subsystem has gathered. The analytics module examines fullness readings, compares against preset criteria, and creates events when a threshold is exceeded. The workstation receives data from the bin sub-system, and a graphical user interface displays useful data to users.

PAPER 7:

TITLE: Design and Development of Smart Waste Management System: A Mobile App for Connecting and Monitoring Dustbin Using IoT

AUTHOR NAME: Na Jong Shen, Azham Hussain and Yuhanis Yusof

PUBLICATION YEAR: 2020

DESCRIPTION:

The Smart Waste Management Method is an extremely creative system that will advance the development of the Smart City. We frequently notice that the garbage cans placed in open areas of our city are always overstuffed. The result is filthy conditions in the city, and Malaysia's present waste management system is not optimised to address the issue. Additionally, the old method of physically checking the garbage in dustbins is a difficult operation that requires a lot more human labour and costs money. A scheme dubbed the Smart Waste Management System is put into place to prevent any such instances. This solution was created to enable mobile applications to communicate with Internet of Things (IoT)-based trash cans. Adaptive Software Development is the approach used to create this project.

PAPER 8:

AUTHOR NAME: Keerthana b et al.

PUBLICATION YEAR: 2017 **DESCRIPTION:**

Designed an internet of bins for trash management in India. When the garbage level reaches its peak, the smart TRASH management system, which uses sensor, microcontroller, and other modules, guarantees that the trash cans are properly emptied. If the waste quantity exceeds one of the two thresholds established for the bins, an alarm message is delivered to the vehicle that picks up the garbage. People may continue to put garbage bags in the bins until they exceed the threshold limit thanks to the technology. To empty the bin, it waits for the van to acknowledge it, and if it doesn't, it sends the message again until it approaches the threshold limit, at which point the bin is locked. When the bin gets locked it displays the message “Overloaded”. Then the dustbin will be monitored for a specific time and when not cleared within a certain time limit, then a message will be sent to the higher authority who can take appropriate action.

PAPER 9:

TITLE: IoT based smart garbage collection system

AUTHOR NAME: Rahul Kumar Borah, Sahana Shetty, Rahul Patidar, Anisha Raniwala and Kratee Jain

PUBLICATION YEAR: 2018 **DESCRIPTION:**

To create an effective and dynamic waste management system, the smart trash container is crucial. One of the most significant challenges for municipal organisations across the world is managing waste from its inception to transfer. Due to the daily growth in garbage, dustbins placed across finished urban areas and placed in open areas are overflowing, creating unsanitary circumstances for the residents. To maintain a crucial barrier from such a situation, we have proposed a remote strong waste management prototype for smart urban groups. This prototype enables common associations to remotely monitor the status of trash cans, complete web server, and profitably maintain urban areas clean by increasing the cost and time required for it.

PAPER 10:

TITLE: Smart City Waste Management System using IoT and Cloud Computing.

AUTHOR NAME: Aderemi A. Atayero, Segun I. Popoola, Rotimi Williams, Joke A. Badejo and Sanjay Misra

PUBLICATION YEAR: 2021 DESCRIPTION:

Solid waste disposal without consideration is a significant problem in the metropolitan areas of most developing nations, and it seriously jeopardizes the residents' ability to live a healthy lifestyle. Both the local government and the populace will benefit from having access to trustworthy data on the situation with solid waste at various points across the city. In this study, the Internet of Things (IoT) and cloud computing technologies are used to create an intelligent solid waste monitoring system. Ultrasonic sensors are used to measure the solid waste fill levels in each of the containers, which are placed in strategic locations around the community. The sensor data is sent through a Wireless Fidelity (Wi-Fi) communication link to the Thing Speak IoT cloud platform.

2.3 Problem Statement Definition:

Problem Statement (PS)	I am (Customer)	I'm trying to	But	Because	Which makes mefeel
PS-1	Municipal corporation authority	Get notified when the trash cans are full and be made aware of wherethe full cans are located.	Don't havethe facilities atthe moment	There is no toolavailable to determine the level of bins.	Frustrated
PS-2	Individual working for a private limited corporation	Get rid of the example of a surplus of waste	The trash cans are always filled	I occupy a metropolitan where there is acity is invariably crowd.	Worried

3. IDEATION & PROPOSED SOLUTION

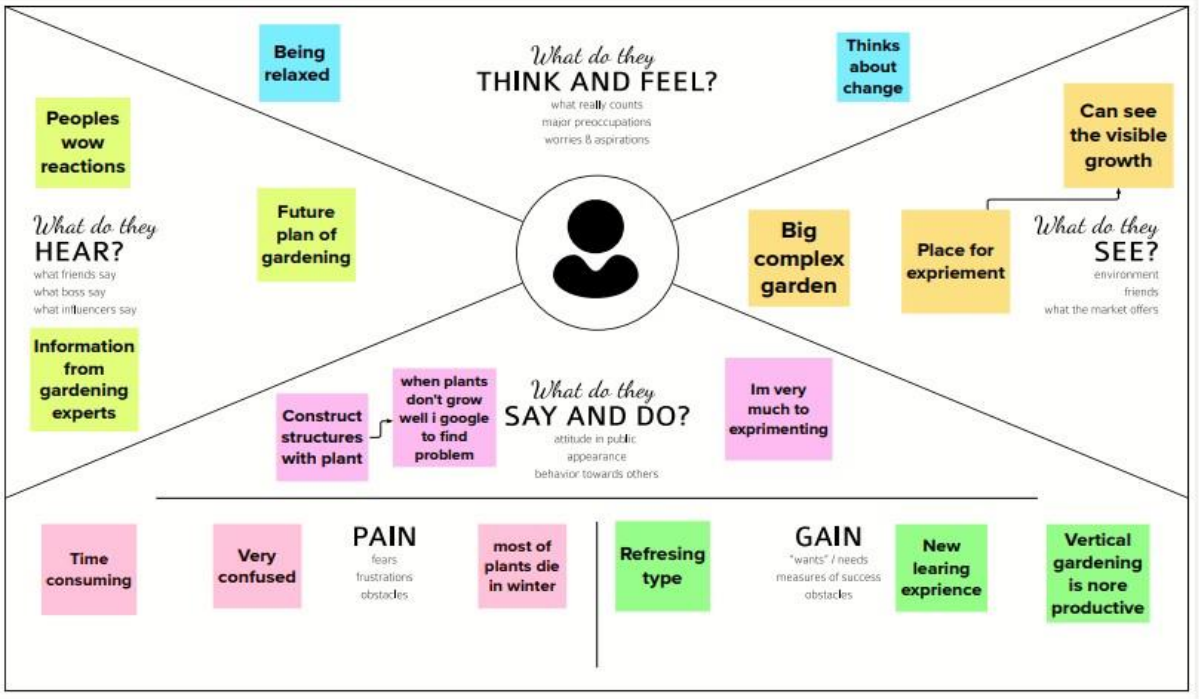
3.1 Empathy Map Canvas

Empathy Map Canvas

Gain insight and understanding on solving customer problems.

1

Build empathy and keep your focus on the user by putting yourself in their shoes.



Share your feedback

3.2 Ideation & Brainstorming

2

Brainstorm

Write down any ideas that come to mind that address your problem statement.

10 minutes

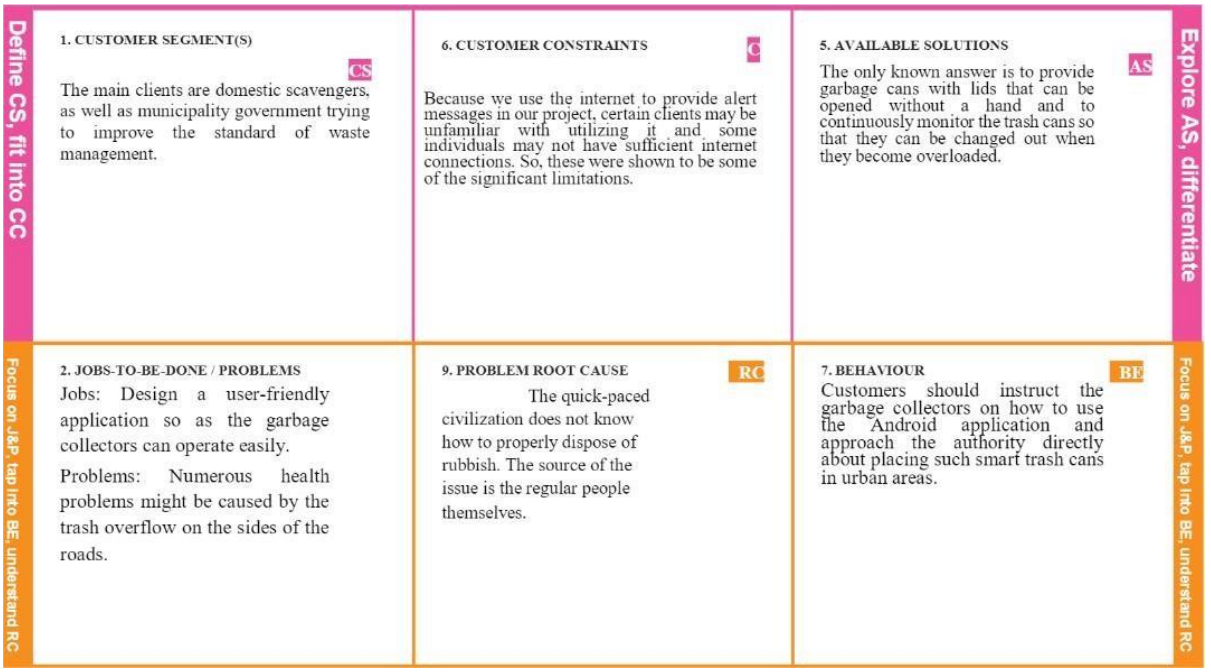
TIP

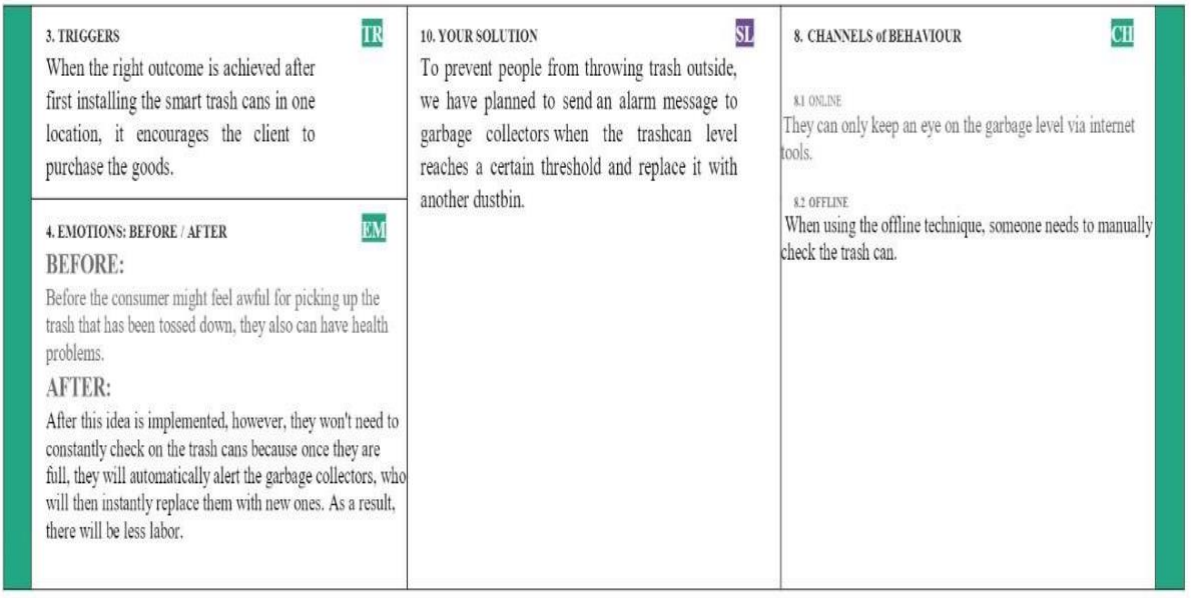
You can select a sticky note and hit the pencil [switch to sketch] icon to start drawing!

3.3 Proposed Solution

S. No	Parameter	Description
1.	Problem Statement (Problem to besolved)	The manual monitoring of wastes in trash cans is a laborious operation that requires additional time, money, and human labor Unsafe trash disposal is generating problems for people. Bad odor all around the place from uncollected trash or rubbish.
2.	Idea / Solution description	This procedure uses a cloud connection and non-bio degradable wastes and an ultrasonic sensor to determine the level of a rubbish container By developing an app, the company of a certain neighborhood inside a large metropolis will be able to check the trash cans to see if they are full or not.
3.	Novelty / Uniqueness	In contrast to the traditional ways for collecting trash cans, this strategy instructs us to utilize the transportationonly when necessary. Keeping an eye on the trash cans easier and less labor-intensive for humans.
4.	Social Impact / Customer Satisfaction	People can experience a cleanatmosphere. Reduces the amount of labor required from humans for wastedisposal. For a municipal corporation to monitorthe cleanliness of different areas of the city, this proposal will be quite helpful.
5.	Business Model (Revenue Model)	By cutting back on unneeded transportation costs to pointless locations, this lowers a significantamount of fuel costs for city businesses. This initiative intends to assistmunicipal corporation. Provide a sanitary atmosphere.

3.4 Problem Solution fit





5. PROJECT DESIGN

5.1 Data Flow Diagrams

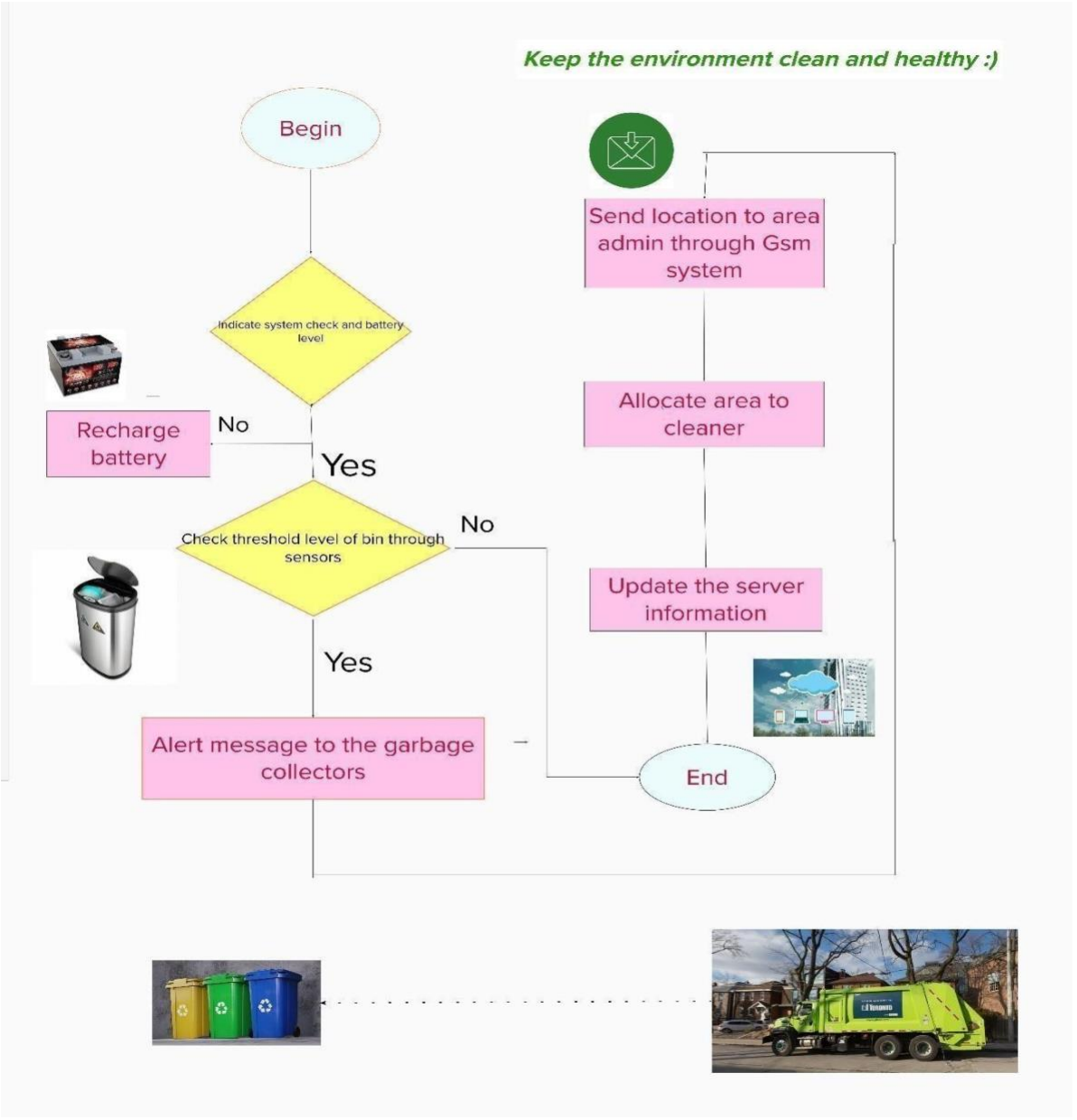
A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirementgraphically.

It shows how data enters and leaves the system, what changes the information, and where data is stored.

A smart waste management platform uses analytics to translate the data gather in your **bins into actionable insights to help you improve your waste services.** You can receive data on metric such as:

- The first test conducted is the situation where the garbage bin is empty or its garbage level is very low
- Then, the bin is filled with more garbage until its level has surpassed the first threshold **value, which is set to 80% then the first warning SMS is being sent, as depicted**
- The first notification SMS sent by the system, once the waste reaches the level of 85% full
- The second notification SMS sent by the system, indicating that bin is at least 95% full and **the garbage needs to be collected immediately**
- Locations prone to overflow
- The number of bins needed to avoid overflowing waste
- The number of collection services that could be saved
- The amount of fuel that could be saved
- The driving distance that could be saved

Data flow diagram:

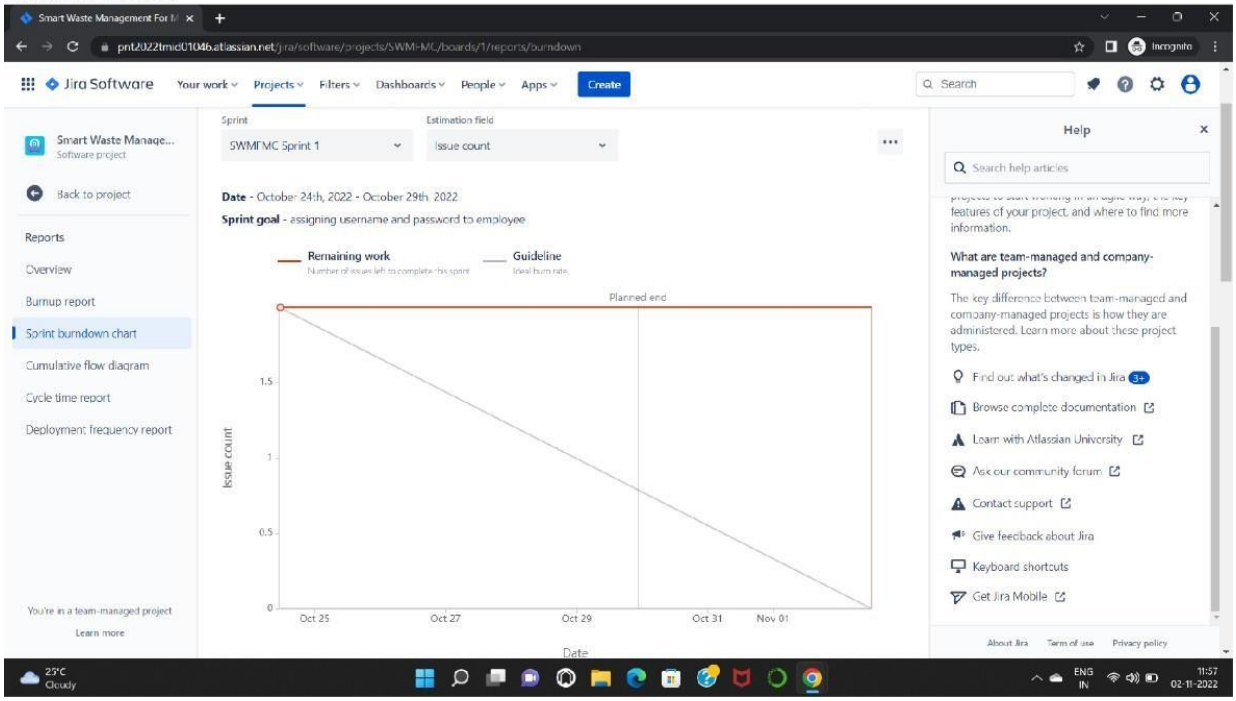

Keep the environment clean and healthy :)
Begin
Indicate system check and battery level
Recharge battery
No
Yes
Check threshold level of bin through sensors
No
Yes
Alert message to the garbage collectors
Send location to area admin through Gsm system
Allocate area to cleaner
Update the server information
End

5.2 Solution & Technical Architecture:

Table-1: Components & Technologies:

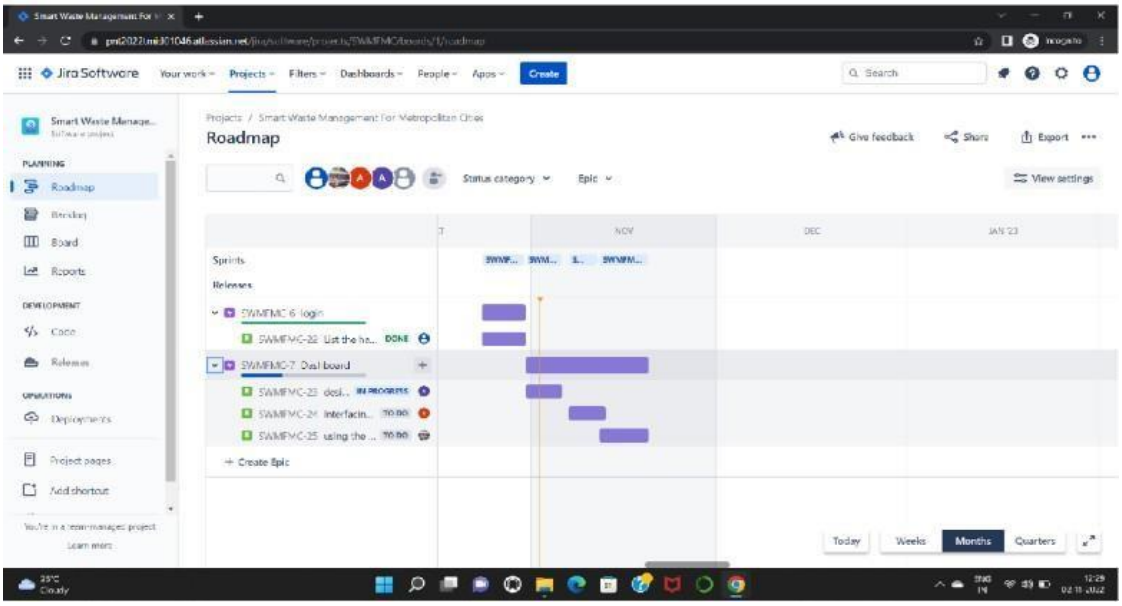
S.no	Component	Description	Technology

BURNOUT CHART:

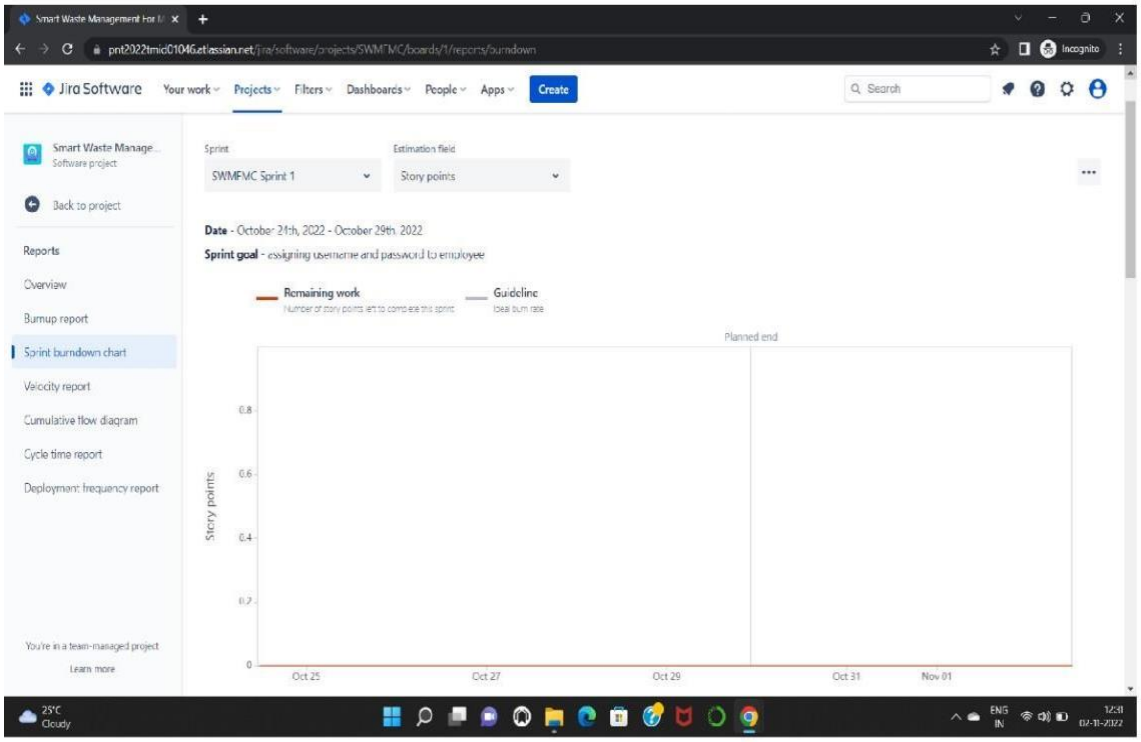


Jira Software Screenshots:

ROADMAP

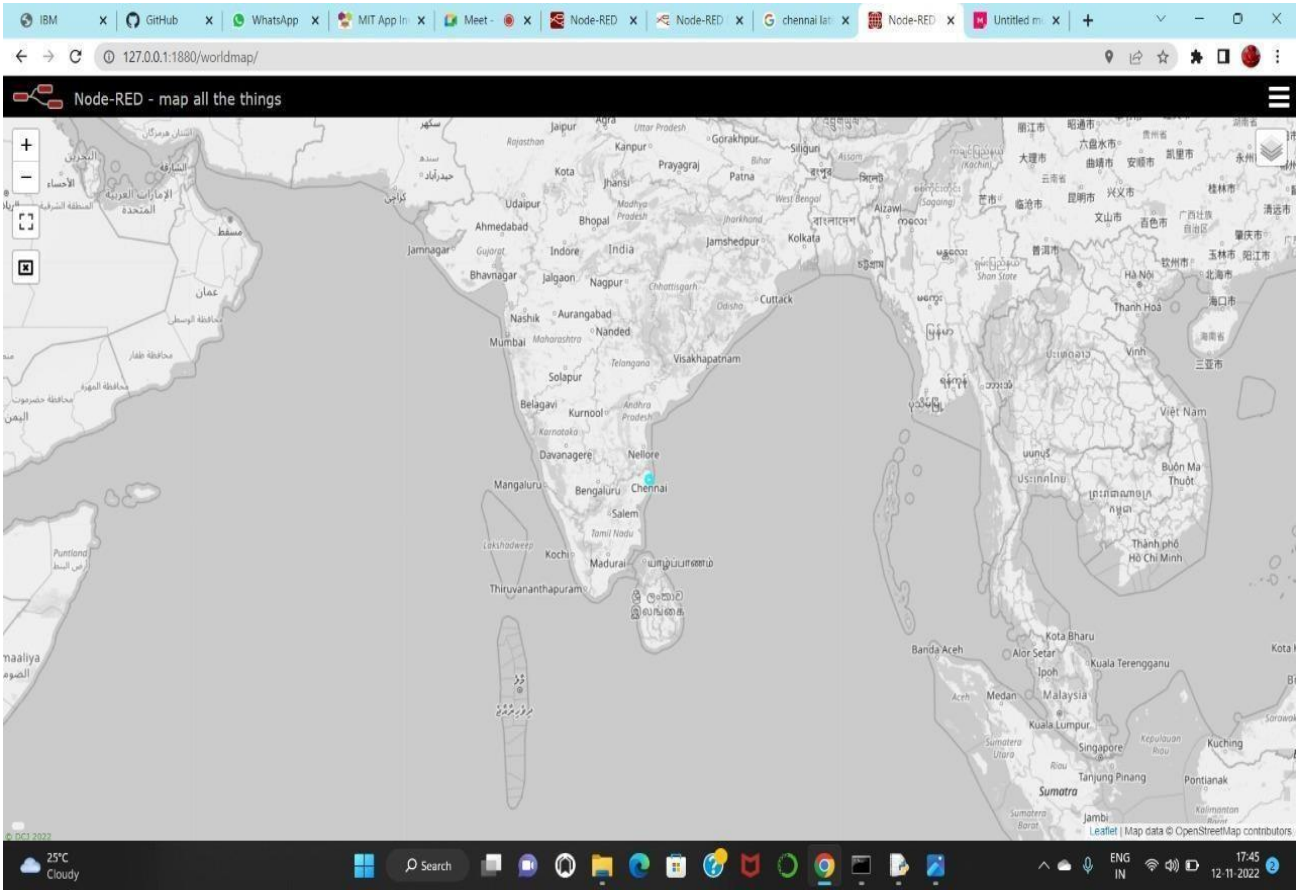


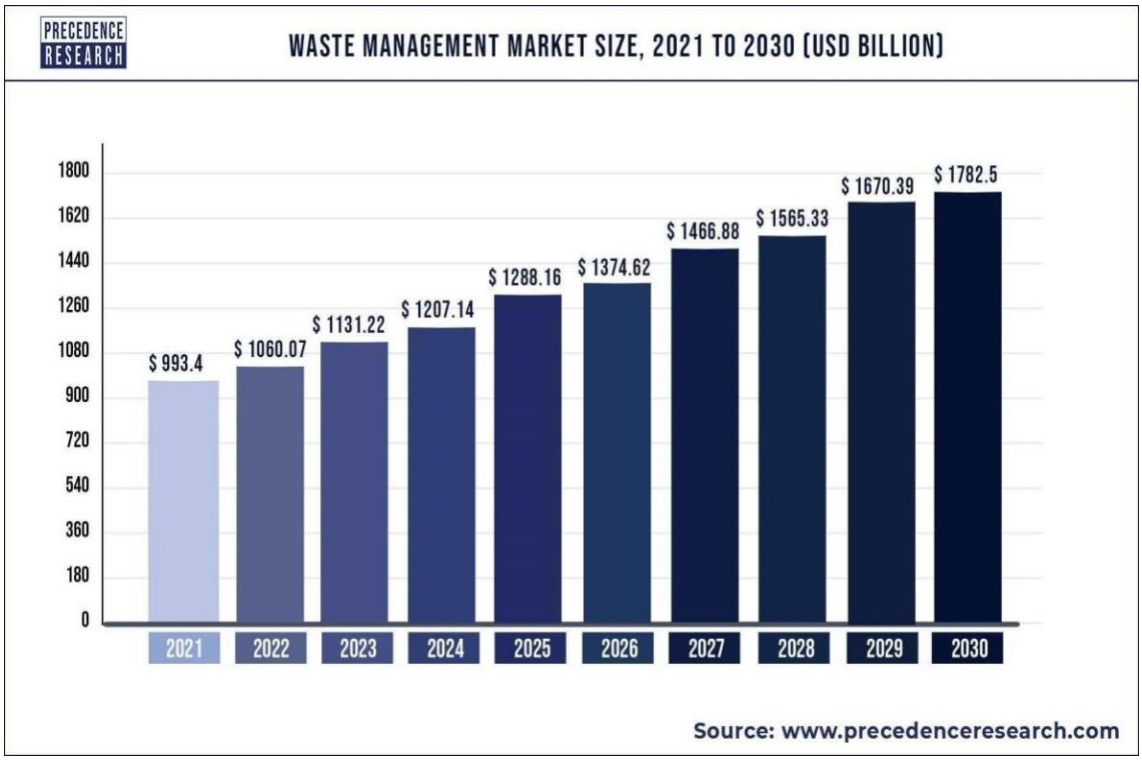
PNT



7. CODING & SOLUTIONING (Explain the features added in the project along with code)

7.1Feature 1- LOCATION TRACKER





9. ADVANTAGES & DISADVANTAGES

ADVANTAGES:

- Reduction in Collection Cost
- No Missed Pickups
- Reduced Overflows
- Waste Generation Analysis
- CO2 Emission Reduction

DISADVANTAGES:

- System requires a greater number of waste bins for separate waste collection as per population in the city.
- This results into high initial cost due to expensive smart dustbins compare to other methods.
- Sensor nodes used in the dustbins have limited memory size.

10. CONCLUSION

A Smart Waste Management system that is more effective than the one in use now is achievable by using sensors to monitor the filling of bins. Our conception of a "smart waste management system" focuses on monitoring waste management, offering intelligent technology for waste systems, eliminating human intervention, minimizing human time and effort, and producing a healthy and trash-free environment. The suggested approach can be implemented in smart cities where residents have busy schedules that provide little time for garbage management. If desired, the bins might be put into place in a metropolis where a sizable container would be able to hold enough solid trash for a single unit. The price might be high.

11. FUTURE SCOPE

There are several future works and improvements for the proposed system, including the following:

1. Change the system of user authentication and atomic lock of bins, which would aid in protecting the bin from damage or theft.

2. The concept of green points would encourage the involvement of residents or end users, making the idea successful and aiding in the achievement of collaborative waste management efforts, thus fulfilling the idea of Swachh Bharath.

3. Having case study or data analytics on the type and times waste is collected on different days or seasons, making bin filling predictable and removing the reliance on electronic components, and fixing the coordinates.

4. Improving the Server's and Android's graphical interfaces